How geothermal has changed people's thinking in Veresegyház?

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ABSTRACT

Veresegyház is a small town north-east of Budapest, capital of Hungary (1. Figure). The first geothermal well was drilled in 1987. The water is gained from Triassic karst reservoir at the depth of 1450 m. The wellhead temperature at moderate flow-rate (30m^3/h) was 64^{o}C. Utilization of hot water started in 1992 in an open-air swimming pool next to the well. Decision on energetic use was taken in 1993 when the grammar school was supplied by geothermal water via 680 m long pipeline. By the end of 2015 three other wells have been drilled and more than 60 consumers (heat stations) have been connected to the pipeline grid, which has been extended to 18 km long. Peoples in Veresegyház have taken to the geothermal. After 22 years of energetic use no one in the settlement wants to heat with natural gas. Investors of new buildings, either residential or public ones, and also industrial facilities require geothermal.

1. Figure Location of Veresegyház in Hungary

1. INTRODUCTION

Veresegyház: an extraordinary settlement in Hungary.

The name of the town means "Red Church". (Remark: each Hungarian settlement has got a name with meaning.)

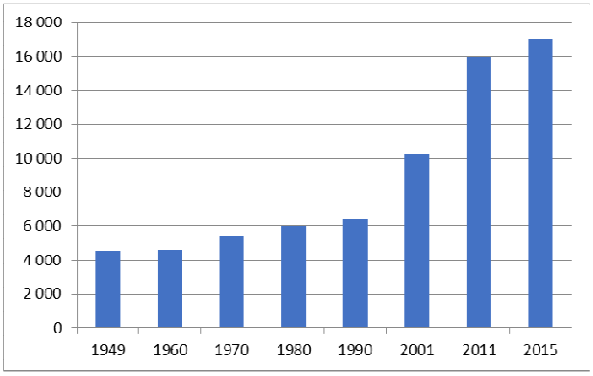
The main activity of the inhabitants in Veresegyház was the agriculture, as usually in Hungary. Productivity of the weak soil did not allow the people to grow rich. The village had been entitled as the "breadless" village, featuring the pecuniary capability of the residents. Probably this was the reason why decision of locating a large-scale industrial factory, a pharmaceutical one was made in the socialist times and the building of Chinoin Co. (later: Sanofi) were erected.

It was still in 1965 when an ambitious young man, Mr. Béla Pásztor (2. Figure) was appointed to the head of the council, i.e. the soviet type of local government. Even though he had never been the member of communist party he managed to give a great energy to the settlement. So, it was evident that later on, after the political and economic changes in 1990 he was elected the mayor. Since then he has been re-elected continuously and celebrated his 50 anniversary of leading the settlement in 2015.

2. Figure Mr. Béla Pásztor mayor - since 1965

During his leadership Veresegyház has taken a fantastic improvement. From the grade of village it obtained the town status in 1999. Population has been growing rapidly. While the number of inhabitants was around 6000 in 1990 it raised to 18000 by the year of 2015. It is shown on 3. Figure.

Thus, in the past 25 year a number of houses, flats, schools, kindergartens, immense public and industrial buildings were implemented. There is, practically, no unemployment in the town. Half of the citizens commute to Budapest, capital of Hungary, the other half can take up situation easily at large international companies and the hundreds of small and medium size local enterprises.



3. Figure Growth of population in Veresegyház

It is obvious that the municipality of Veresegyház lead by Mr. Pásztor follows clear strategy for developing the town. One of the goals of the strategy is to mitigate dependency of energy supply from imported natural gas and to rely on local renewable energy sources.

2. THE GEOTHERMAL SYSTEM

There was only a single aim when the first geothermal well was drilled in 1987: to find water. After it succeeded the second aim was to use it for bathing. No one in Veresegyház thought of utilizing the hot water for energetic purposes and, no one could foresee the bright future.

In the chapters below the evaluation of Hungary's largest urban geothermal heating system will be introduced gradually, as the wells were drilled.

2.1 The first well: B-15 for production (1987)

The idea to lower a deep well to get hot water from the earth came from a Veresegyház citizen, a geologist, who encouraged the village's leadership to start with the work. In the 80's, however, very limited geological and hydrogeological data were available from the vicinity of the settlement. The closest thermal water well in operation located some 25 km to the southwest in Budapest. Risk of water exploration was fairly high. In spite of that the local community raised the money – a high sum one for their capability – and drilling could start.

After two months of hard work the drill-runner knocked on the mayor's door and said: "Sir, the well is punctured". The mayor did not understand it and thought about a technical accident. However, the drill-runner looked happy, and explained that they experienced total mud losses, what they called "puncture" on the well, which was proof of success. Later on, after the well tests had been carried out they measured 64°C temperature at 30m^3/h yield.

All the people in the village were very happy about the results. They soon deepened the bed of the stream and placed stone benches along the two coasts. Thus they developed a bath with mixing the hot thermal water and cold water of the stream. The authority for public health obviously did not like the solution. So, in 1992 an outdoor swimming pool was built, which has been operating since then.

In 1993, the city leaders agreed the proposal from an expert company to fulfil heating demands of the primary school with thermal water. This was the first step in the utilization of geothermal energy. The project proved a shiny success both technically and financially. The invested money paid itself back within 3 years as a result of the lack of oil-fuel.

4. Figure Vicinity of well B-15

Right after the first energetic investment returned and seeing its success other public buildings were connected to the geothermal well via a new pipeline in 1997. All of them were using oil-fuel, which was the most expensive source those times. And when, due to the growth of the population, it became inevitable to construct a new elementary school, it was obvious that it would be heated by geothermal water.

Geothermal consumers of the period:

- Fabriczius Elementary School
- Culture House
- Music School
- Kindergartens (Red and Green)
- Mézesvölgyi Elementary School

2.2 The second well: K-23 for reinjection (2007)

The town leadership, becoming enthusiastic over the success of achievements reached previously decided to extend geothermal heating all the inner city public buildings. The well B-15 was still running only half of its capacity, so it could have loaded to greater extent. A new regulation in the water management law, however, made the reinjection of cooled geothermal brines by energetic uses compulsory in Hungary. Thus increase of production of thermal water could only be licensed by authority if reinjection was solved.

5. Figure Vicinity of reinjection well K-23

Location of the new well for reinjection was appointed some 1,6 km away from the production one. Hydrogeologists assumed that a fault could be found there and, when the well was drilled in 2007 it come truth.

New consumers of geothermal heat by the investment in 2006-2007 are as follows:

- Calvinistic Parsonage
- Cinema
- Main Square Shopping Centre
- Innovation Centre
- Post Office
- Old Town Hall
- Municipal Nursing Homes
- Old Catholic Church
- Catholic Parish
- Szent Pió Elderly Home
- Mission" Hospital
- Gyermekliget Kindergarten

Sending the geothermal water to the consumers a lot of pipelines had to be built. The total route of the transmission and distribution network was some 6,5 km.

The local municipality could absorb non-refundable grant through an EU-based program. It covered 40% of the costs of the investment.

Development of the geothermal grid did not stop in the coming years and some other building from own financial sources were switched from natural gas to geothermal heating.

- Diakonia Elderly Home
- Lehár Gated Community
- Csonkás Kindergarten
- Meseliget Nursery
- Private House

2.3 The third well: K-25 for production (2011)

The European Union funds continued to be available, in addition to a greater intensity than before. Therefore, the government decided in 2008 to continue with developing the geothermal system.

The idea aimed mainly at the great enterprises of the town since demand for the use of cheap and environmentally friendly renewable energy also raised on their part. As the first well (B-15) had fully been loaded by the previous project, a new production well had to be lowered. After one year of preparation it was implemented at the middle of 2011. Productivity of it turned out excellent. The outflow temperature was as expected, i.e. 66°C. The large diameter (13 3/8") casing from the top to -200m allows large capacity deep well pump to be installed.

There was no need to drill new reinjection well since the old one could swallow twice as much as produced from old production well. Only the reinjection pump station had to be replaced by slightly bigger unit.

6. Figure Vicinity of well K-25

The total length of pipeline route was 5,9 km this time. The municipality, as investor could involve 60% of the investment costs as financial contribution from the EU fund called Environment and Energy Operative Program.

New consumers of the development in 2011 are:

- Sanofi Pharmaceutical Co.
- Juko Ltd.
- Mey Textil Co.
- General Electric Aviation Co.
- General Electric Energy Co.

The brilliant productivity of the new well formed some extra (surplus) capacity suitable to supply more consumers during the period to 2015, which are the followings:

- Őszi Liget Elderly Home
- Csonkás block of flats
- Calvinistic School
- Calvinistic Church
- Sports Locker Room
- Town Hall (the new one)
- Lévai kindergarten
- Horváth Gipsz Ltd.

2.4 The fourth well: K-26 for production (2015)

Necessity of the third production well emerged when an investor for constructing a 3,2 ha greenhouse plant appeared in the town. He sought after a settlement where large enough land and cheap geothermal energy were available. Both could be found in Veresegyház – with the only problem that capacity of the two existing production well were almost fully utilized.

7. Figure Vicinity of well K-26

Location of the forth well was determined still in 2011 by a hydrogeological study, which pointed out clearly that location of the karstic reservoir would be at a lower position then in the previous wells. However, when it was being implemented in 2015 and the driller passed the depth of 1600 m without any loss of mud everyone got a bit nervous. But, a town like Veresegyház deserves to be lucky: drilling to further down brought success. Water was discovered below 1700m. In return for the fright, temperature became higher than expected. It went up 72°C at the maximum flow rate.

It was the local government who financed the project by 100%, without any support from the state. It contained the well, geothermal technology with pumps and a pump house and 2,4 km long pipeline at particularly large diameter. Capacity of reinjection needed enlargement too.

Number of new consumers was only a few:

- 3,2 ha greenhouse
- Block of flats (190 flats)
- GE Aviation Co. – new production hall

However, after the above listed entities having been connected to the geothermal network heat from the renewable source increased significantly.

2.5 Situation at present

The most important technical figures of the Veresegyház geothermal system are listed in 1. Table

1. Table Technical figures for the system

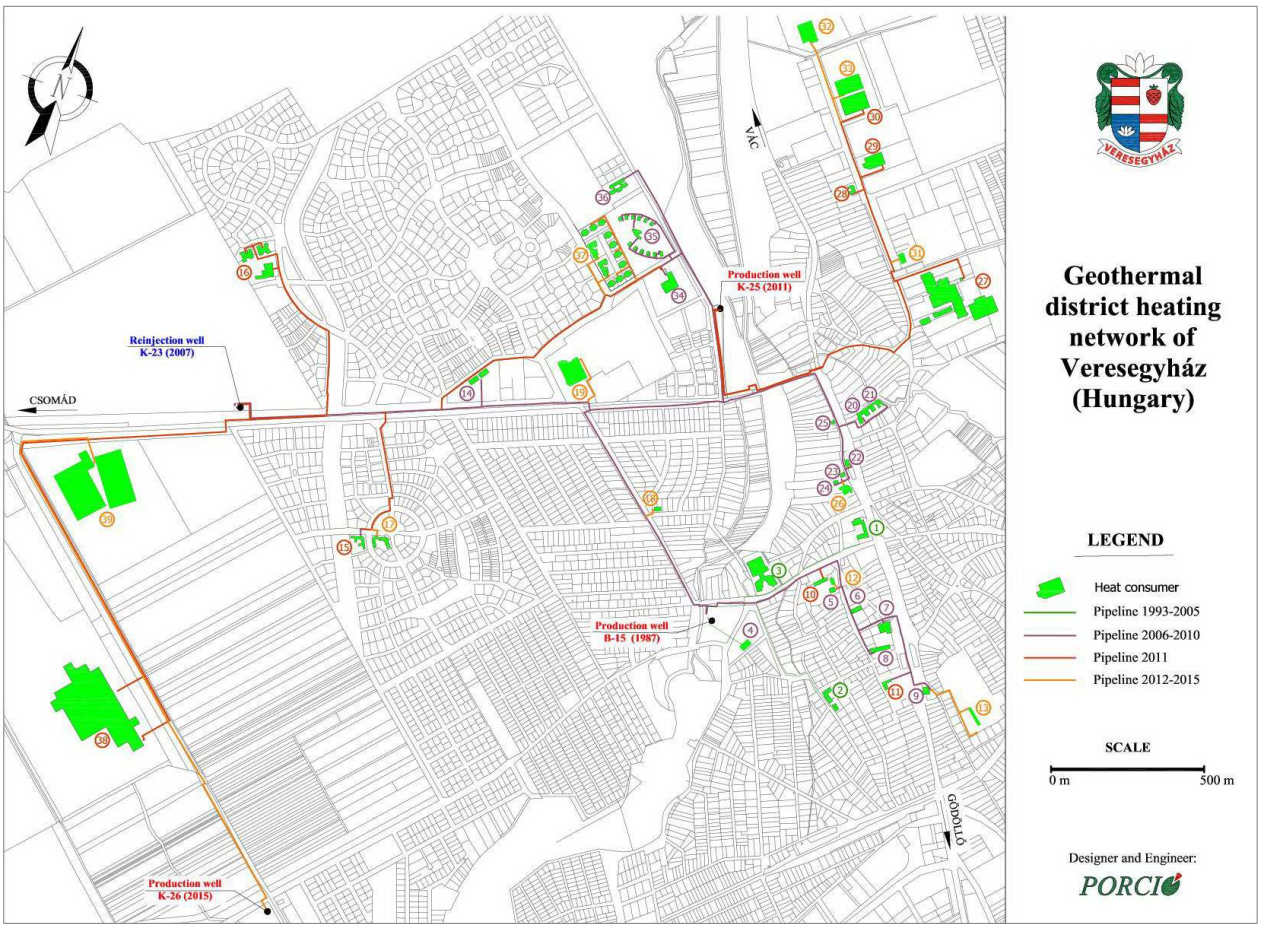
Number of wells	4 pcs
Number of heat station	63 pcs
Lenght of pipeline network	18 km
Water exploited per year	1,350,000 m3
Reinjected volume	1,250,000 m3
Installed geothermal capacity	12.1 MW
Heat produced per year	115 TJ (32 GWh)

Since the last year project finished the number of consumers has widened by three ones in the beginning of 2016:

- New Catholic Church
- Supermarket CBA
- Block of flats (78 flats)

And there are many others waiting for their run: a primary school, a grammar school, two sport halls, 46+110 flats, 3 ha greenhouse, etc.

Site map of the Veresegyház geothermal network is shown on 8. Figure, while the list of consumers is introduced by 2. Table.



8. Figure Site map of the Veresegyház geothermal network as the end of 2015

2. Table List of geothermal heat consumers in Veresegyház

Nr.	Name	Public	Corp.	Private	Nr.	Name	Public	Corp.	Private
1	Fabriczius Elementary School	X			21	Municipal Nursing Homes	X		
2	House of Culture	X			22	Old Catholic Church	X		
3	Mézesvölgyi Elementary School	X			23	Catholic Parish	X		
4	Thermal Spa Dressing Room	X			24	Szent Pió Elderly Home	X		
5	Calvinistic Parsonage	X			25	Private House			X
6	Cinema	X			26	New Catholic Church	X		
7	Main Square Shopping Centre		X		27	Sanofi Pharmaceutical Co.		X	
8	Innovation Centre	X			28	Juko Ltd.		X	
9	Post Office		X		29	Mey Textil Co.		X	
10	Calvinistic School	X			30	General Electric Aviation Co.		X	
11	Town Hall	X			31	Lévai kindergarten	X		
12	Calvinistic Church	X			32	Horváth Gipsz Ltd.		X	
13	Sports Locker Room	X			33	GE Aviation Co. New prod. hall		X	
14	Lehár Gated Community			X	34	Mission Hospital	X		
15	Csonkás Kindergarten	X			35	Gyermekliget Kindergarten	X		
16	Diakonia Elderly Home	X			36	Meseliget Nursery	X		
17	Csonkás block of flats			X	37	Blocks of flats (190 flat)			X
18	Őszi Liget Elderly Home	X			38	General Electric Energy Co.		X	
19	CBA Supermarket		X		39	Horticulture (3.2 ha glasshouse)		X	
20	Old Town Hall	X							

3. WAY TO THE GEOTHERMAL SUSSESS

Four short stories tell a lot about the Veresegyház success.

3.1 Scepticism and convincement

The mayor was not easy to convince to start with the geothermal heating in 1993, i.e. to do he first step. It was Mr. Lajos Csontos from Porció Ltd. who suggested the utilization of thermal energy in the primary school. However, decision on the project had not been born for a long time. The city's leadership, headed by the mayor seemed to hesitate. It was no use even to show the delegation formed from the members of local board places where thermal water had been already used in public buildings. They did not really believe that it would work in Veresegyház. Finally, the manager of Porció Ltd. offered the mayor that the company would on its own financing implement the geothermal heating for the school, and would operate it for 10 years. Then the mayor decided so that the municipality would make the investment. Thus, the expert company was ordered to prepare plans for the geothermal heating and also to implement the system.

The deadline was 15 October 1993, which is the official start of the heating season in Hungary. On this day the mayor personally went down to the school's boiler house, where satisfied that the fossil fuel boilers were not working. Then he went to the classrooms and felt the radiators, whether they were hot or not. He was not slothful either to go to the farthest radiator in order to check the heating system. It noted with satisfaction that the heating worked.

This was a real turning point that effected all the further developments. The doubt was gone and replaced by a trust in geothermal.

Outlook of the school is shown on 9. Figure.

9. Figure Main entrance of Fabriczius School

3.2 The first private house on the grid

In 2009 a strange request from an elder lady came towards the mayor to let her connecting her house (10. Figure) to the geothermal grid. She knew that geothermal pipelines were laid under the pavement just in front of her private house. There was not natural gas fired boiler in the building and the lady had been under the necessity of firing with wood, which caused very difficult job for her.

10. Figure Private house heated by geothermal

The mayor permitted the investment and the lady ordered the implementation. There was only one problem: the price of the works. Accustomed solution resulted very high price, almost unaffordable for the lady. So, a special heating substation had to be invented in order to reduce the cost.

Both the designer company and the lady were excited when the extraordinary geothermal equipment was put into operation in October 2009. Since then it has been working smoothly for the satisfaction of three sides: the lady, the mayor and the entrepreneur.

3.3 The first memorial tablet

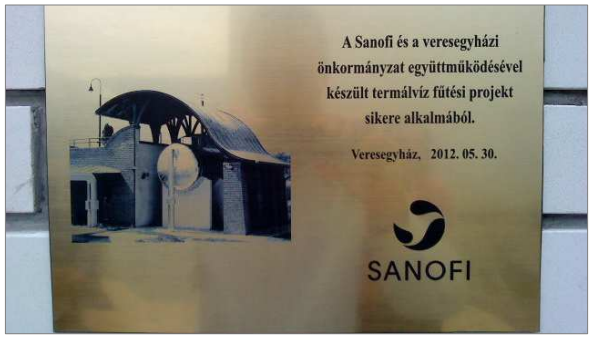
Sanofi is a widely known large transnational pharmaceutical company. After the political and economic changes in 1990 it bought the former socialist company called Chinoin. During the times the factory was modernized and enlarged.

Local management of Sanofi Co. has always been extremely sensitive for environmental issues and they have made serious efforts for sustainability. Being informed about the hydrothermal aquifer under the settlement the head of department for facilities and utility services ordered a feasibility study on the possible conditions of geothermal heating for the plant. The study, which was elaborated in 2007 clearly proved that energy supply by geothermal was technically feasible but economically not viable. Namely, even one thermal water well may provide energy as much as the consumption of three or four Sanofi plant in Veresegyház. The only way to take over the problem was to cooperate with the municipality.

The agreement – contracted verbally only – contained that municipality would make drilled a new well and conducted the hot water to the site and Sanofi would enlarge its boiler station in order to ensure room for the geothermal equipment. As it happened so in 2011.

Geothermal energy supply started on a Monday in October, 2011 and it has been operating since then without problems. All members of the Sanofi's management staff were grateful to the mayor and the town of Veresegyház and looked really very happy about the success. They were proud of the green energy solution too and propagated it throughout the Sanofi Group information channels. The Veresegyház plant entered different competitions and calls for award with the subject of green energy and sustainability and they succeeded.

In May, 2012 after ending the first heating season by geothermal a memorial tablet was placed on to the wall of boiler station (11. Figure) saying: "*Placed on the occasion of the successful geothermal heating system based on cooperation between Sanofi and the Municipality of Veresegyház.*"



11. Figure Tablet in Sanofi plant

3.4 Independency from imported gas

Buildings of the "*Meseliget*" Nursery were erected in 2008 (12. Figure) and, at the same time, geothermal heating was also implemented. Since then natural gas has been used only to cook the meal for thermal water could cover the all the heating and domestic hot water demands. Everything was nice and well operating. The years passed peacefully.

12. Figure Meseliget Nursery

Once in wintertime, however, the telephone rang in the mayor's office. It was the leader of Nursery on the line and seemed very upset when she told the mayor that technicians from the gas service company switched off the building from gas supply. The workers remarked that their action had been legitimate, since the bill was not paid yet. The mayor asked the leader whether they had cooked the meal and she answered they already had. Then the mayor told the lady to calm down. There was not any problem. On one hand kids would have their lunch, so they wouldn't remain hungry and, on the other hand heating did not require gas, since it was based on thermal water. Anyhow, as it revealed later, someone in mayoral office neglected by mistake to pay the gas-bill. Luckily, it could not cause any serious problem due to the geothermal. Residue, of course, was paid off the next day.

4. CONCLUSIONS

What are the key elements to the success in Veresegyház? It is easy to answer: bravery in initiatives, honesty in business, low price of energy, operable municipality, healthy local community with openness to the world – and a good leader.

People in Veresegyház have known geothermal. For heating everybody think of using thermal water as the first alternative. It is simply wonderful!